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THE ROLE OF SELF-PACING IN LEARNING TO MEMORIZE.

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TWO GROUPS OF SUBJECTS, DESIGNATED PACED AND UNPACED, WERE USED TO DETERMINE WHETHER SELF-PACING IS ADVANTAGEOUS OR NECESSARY IN THE DEVELOPMENT OF EFFICIENT TECHNIQUES OF MEMORIZING. EACH GROUP LEARNED 8 LISTS OF 25 WORDS EACH, 2 LISTS PER SESSION. AT THE FIFTH SESSION, THE PACED GROUP LEARNED TWO ADDITIONAL LISTS UNDER SELF-PACED CONDITIONS. DURING THE SAME SESSION THEY WERE TESTED WITH A 50-WORD LIST UNDER PACED CONDITIONS. THE UNPACED GROUP LEARNED 2 ADDITIONAL LISTS UNDER PACED CONDITIONS, AND WERE TESTED WITH A 50-WORD LIST UNDER UNPACED CONDITIONS. THE RESULTS SHOWED THAT (1) BOTH GROUPS INPROVED WITH PRACTICE, (2) THE GROUPS DID NOT DIFFER IN TOTAL LEARNING TIME, AND (3) THE GROUPS DID NOT DIFFER IN RECALL. THE RESULTS LEAD TO THE CONCLUSIONS THAT (1) MNEMONIC TECHNIQUES APPARENTLY ARE NOT EASILY TAUGHT OR CHANGED BY THE METHODS USED, (2) PACED AND UNPACED LEARNING ARE EQUALLY EFFECTIVE, AND (3) PACED AND UNPACED LEARNING LEAD TO COMPARABLE 48-HOUR RETENTION. (AW)

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The role of self-pacing in learning to memorize

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Problem

It is often claimed, usually by self-styled memory "experts," that there are learnable mnemonic techniques which will enable one to memorize more efficiently than is ordinarily possible. One would expect that a knowledge of effective techniques of memorizing would be of great assistance in clarifying the basic principles of learning and memory, to say nothing of its practical value. However, in experimental research on learning and memory, very little attention has been paid to mnemonics--we simply do not know whether they are effective, whether they are more effective than other methods, or if effective, why. This lack of empirical knowledge probably reflects, among other things, two assumptions concerning the performances of mnemonic experts: (1) that the expert is an individual with an unusual ability and hence studying him tells us little of value about "normal" individuals, or (2) that the expert is doing nothing which involves different techniques (or different processes) than those commonly employed in the laboratory and in everyday memorization. Since neither of these assumptions can be well supported by available research findings, the possibility still exists that the mnemonic expert is using techniques which differ from those usually used, and that these techniques could be more widely taught. While such a possibility still exists, mnemonics deserve closer study. As a first step, it would seem reasonable to see whether the exceptionally good memorizing reported by trained mnemonicists can be duplicated using standard laboratory methods.

Related Research and Objectives

Very little of the literature on mnemonics is directly relevant. Much of it is anecdotal. Of experimental studies, there are several, such as those of Adams (1962) and Rothkopf (1963) which indicate that learning materials may or may not be made easier to master if they are elaborated with mnemonic phrases or other "aids." Only two reports, one of them unpublished, deal with the question of whether Ss can, with practice, develop techniques of memorizing which are equal to those of mnemonic experts who perform publicly. In the first, Renshaw (1927) had a class of students practice memorizing the order of a deck of playing cards, a feat which they had seen a stage mnemonicist perform. After varying amount of practice, most of them succeeded: exactly what sort of practice is required, and what gets learned were not apparent from Renshaw's results, although it is interesting to see that the feat is within the capability of college students. The second study, by Wallace, Turner, & Perkins (1957) is similar to Renshaw's: a small number of Ss demonstrated that with practice they could learn as many as 500-700 paired associates with a single presentation of each item. Six subjects were used, and the data are sketchily described rather than being presented in any detail. Although each item was presented only once, S was allowed all the time he needed to study it, and was given as many rest pauses as he needed. The rest pauses were apparently not filled with other activities, and could conceivably have served as extra time for study and review. According to Wallace et. al., the Ss began by tackling short (25-item) lists, and taking a very long time (in the neighborhood of 30 sec. per word) for each item. With practice they improved to the point of tackling lists containing up to 500-700 items, at rates as high as 3-4 sec. per item. It is worth pointing out that the procedure followed by Wallace, et al. does not allow us to conclude that the Ss actually improved in performance--it is possible

that early in the experiment they were taking far more time than they actually needed, and that they gradually discovered this fact and reduced their caution concerning number of items and per item required.

The studies of Renshaw (1927) and Wallace et. al (1957) differ from conventional laboratory studies of learning and memory in two respects: first the degree of performance attained seems much higher than is usually expected in laboratory tasks, and second, the tasks employed appear in some ways to be much easier. One naturally wonders if the second difference will explain the first. Would subjects practicing the same materials at faster controlled rates, be able to learn them as effectively? Would they learn as effectively to improve their memorization? Or is it the case, instead, that only with unlimited time can the necessary skills be acquired? While Renshaw's experiment did involve paced presentation, no previous attempt has been made to compare the abilities gained by relatively "free" techniques like those of Wallace et. al. with the paced techniques commonly used in laboratory studies of learning. It is a very likely possibility that Ss who practice at a rapid rate from the beginning are never able to learn techniques which would eventually allow them to perform better at the same rapid rate, while Ss who are allowed a more leisurely pace to start with might learn these techniques. The experiment to be described is concerned with this question. Subjects were allowed unlimited time to learn, or they were presented materials at a fixed rate. An attempt was made to see how well they could learn under these conditions, and whether they would differ in their ability to improve with practice in learning.

Procedure

Design.--There were two groups of subjects, designated Paced and Unpaced. The paced subjects learned 8 lists of 25 words each, 2 lists per session, with each word presented for approximately 4.4 seconds (controlled by an automatic slide projector). Following this, they appeared for a 5th experimental session, at which time they were required to learn 2 additional 25-word lists under self-paced conditions. Finally, during the same session, they were tested under paced conditions with a 50-word list. The Unpaced group was treated similarly, except that their first 8 lists were self-paced--that is, the subject was able, by pressing a button, to advance to a new item whenever he chose to do so, and no time limit was imposed for the study of individual items. For the Unpaced subjects, the fifth session was devoted to (a) two 25-word lists with paced presentation, followed by (b) a 50-word list under Unpaced conditions. Within each of the Groups, there were 12 subjects, and the subjects learned the lists in different orders, the orders being arranged in such a way that a given list appeared equally often on each of the experimental days.

Materials and apparatus.--The first step in constructing the lists was to make up a pool of all of the high-frequency nouns of the Thorndike-Lorge word count ("high frequency" here include all those nouns in the A and AA categories). From this pool of words, 20 lists were constructed, each of 25 words. The words were first dealt into 30 lists of 30 words each, and lists were eliminated if they contained obvious groups of related words, or seemed in any other way to stand out from the rest. The lists which survived this screening were reduced to 25 words by random selection. The 20 lists were made into 2X2 slides, and were loaded into slide trays, with two lists per tray. The result of this was that the lists were always used in groups of 2; e. g. lists 1 and 2 were always

used together, as were lists 2 and 3, and so forth. The main part of the experiment, comprising the first 8 training lists and the two test lists, used 12 of the 20 lists. The 50-word list learned at the very end of the experiment was made up of lists 13-14, 15-16, or 17-18, with each of the resulting 50-word lists being used equally often. As was stated before, the order of use of lists was balanced in such a way that each set of lists was used equally often in each session of the experiment. Different sets of lists, however, always served as the first or the second lists of these sessions. Since there were 6 different lists as first lists of a session, and six more as second lists of a session, it is unlikely that a serious imbalance occurred in this respect. Furthermore, analyses of the data arranged by list and summed over all other variables, suggested that the lists used were closely comparable in terms of total learning time.

The lists were presented by a Kodak Carousel slide projector. For the Paced procedure, the "5 sec." automatic presentation rate was used. As actually timed, this rate was 4.4 sec per slide. Timing checks were made at several points during the experiment. For the Unpaced procedure, the subject was given a button which, when pressed, advanced the projector. During the data collection phase of the experiment, two projectors were in use simultaneously. In order to record the data of two subjects simultaneously, a tape recorder was used, with each subject's responses being recorded on a separate channel. For those times when a subject's responses could not be monitored directly, the tape was used later to transcribe his responses. In addition, an ink recording was made on paper tape of the intervals between slides for the Unpaced subjects. Subjects were told how to operate the projectors, and at the end of each run through the slides, the subject himself reset the slide tray to the beginning of the series, and started again.

Subjects.--The subjects were students recruited through the campus employment office and by means of notices on the Psychology Department's bulletin boards. They were offered $1.60 an hour. In order to ensure that all subjects were adequately paid, well motivated to continue in the experiment, and not tempted to slow their learning in order to amass more hours of pay, each subject was promised a minimum of two hours' pay per session, regardless of the time actually required. Although the slowest subject required about 1½ hours per session, most of the subjects finished within one hour, and were thus lavishly paid for their efforts. In general, an attempt was made to enlist the subjects as collaborators rather than as guinea pigs, and our impression has been that we succeeded.

Before each subject went through the five sessions outlined in the "Design" section, he was seen for a preliminary session in which he was told something about the experiment, and given some mimeographed materials on mnemonics to study. These materials were mostly taken from Hunter's book Memory (Hunter, 1965), with additional examples from the Roth Memory Course and the report of Wallace, Turner & Perkins (1957). When the subject was given these materials, his schedule for the rest of the experiment was arranged. These schedules were arranged to start the following week, and involved sessions of a possible two-hour duration on Monday-Wednesday-Friday-Monday-Wednesday, or Tuesday-Thursday-Saturday-Tuesday-Thursday, always at the same time of day. It was stressed to subjects that they must finish the experiment to be paid, and that they must arrange a schedule which they were sure they could meet. In only one instance did a schedule have to be changed during the experiment, and there is no indication that

the data were affected thereby.

Briefly, the materials on mnemonics which the subjects read contained two principles: the use of vivid visual images, and paying attention only to two successive items at a time. Before the first experimental session, the experimenter made sure that the materials had been read. At the end of the experiment each subject was interviewed, using a prepared schedule of questions, to see what methods of memorizing had been used.

Results and Conclusions

Total learning time.--Since the Unpaced subjects could spend as much time as they wanted on each item, they could theoretically learn in a single trial if they made that trial long enough. Hence, the two groups could not be compared in terms of trials to learn, and the only comparable measure appeared to be the total time required to learn. The total times for each list for each subject were converted to logarithms, and the log scores averaged for each group separately. These mean total times appear in Table 1. Inspection of the Table indicates that the times are closely comparable for the Paced and the Unpaced subjects. It is also apparent that both groups improved with practice at successive lists, and that both groups showed approximately equal amounts of improvement. Only on the two test lists did the two experimental conditions seem to diverge in total times, with the Paced group (now self-paced) learning faster than the Unpaced group (now performing at the 4.4 sec. paced rate). When the two groups were returned to their "normal" procedure and given 50-word lists, their performances were once more closely comparable. An analysis of variance was carried out, using two scores for each subject, one score being the mean log time for his last two practice lists, while the other was the mean log time for his two test lists. If the two groups did indeed diverge significantly, this should appear as a significant interaction of Groups X Days. The interaction was not significant (Table 3), nor were the main effects of either Days or Groups. Hence the divergence appears to be masked by interindividual variability.

Recall.--At the beginning of each day's session, the subject was given a blank sheet of paper and asked to recall the words he had learned in the previous session. The mean recall scores are presented in Table 2. As would be expected, retention deteriorated through the course of the experiment; this is a standard finding in experiments of this sort (Underwood, 1957). Of more interest is the apparent superiority of the Unpaced subjects in retention. An analysis of variance was performed using total items recalled for each subject: these totals represented the summed recall scores appearing in the Right-hand margin of Table 2. This analysis (Table 4) revealed no significant difference between groups in Recall, and no interaction of groups with Days. The effect of Days was highly significant, and this significant difference indicates that recall got steadily worse through the course of the experiment.

Conclusions.--While the data do show that improvement with practice occurred, there was no difference between subject who learned by a paced and by an unpaced procedure. This finding is quite clear, but its interpretation is rendered difficult by two considerations. First, the expectation that Paced and Unpaced conditions should differ was based upon the assumption that subjects would learn to use the recommended mnemonic techniques. The interview data suggested that subjects used verbal associations and, in

their terms, "stories" rather than visual-image, mnemonics and that they did not change their mode of learning during the experiment. Furthermore, it is entirely possible, judging from the reports of subjects in the Paced condition, that the 4.4 second pacing rate was slow enough to allow all subjects to generate as many mnemonics as they could profitably use. Therefore it may still be worthwhile to compare slow pacing such as that used in the present study, with faster pacing. As to the effectiveness of mnemonics, while this experiment cannot be considered acceptable negative evidence, it certainly appears that a more extended training process concerning the mnemonics themselves, or different techniques altogether, ought to be explored. And finally, with respect to the experiment by Wallace, Turner, and Perkins (1957), the results of this study cast considerable doubt upon the authors' implicit assumption that their subjects were performing as well as they could from the very beginning of the experiment. For a 25-word list of the sort used in this experiment, 4.4 sec per item seems to be all the time required; for Wallace, Turner & Perkins' subjects this was near the terminal rate, and not the initial rate. Differences in materials and in subjects, of course, might invalidate such a comparison, and we do not know how long a list could be tackled by subjects in the present experiment before they started becoming less efficient. Certainly the 50-word list did not strain their capacities.

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Table 1

Mean log total learning times.

Day	List	Group	
		Paced	Unpaced
1	1	3.019	3.030
	2	2.921	2.915
2	3	2.871	2.853
	4	2.850	2.816
3	5	2.867	2.890
	6	2.789	2.816
4	7	2.885	2.833
	8	2.755	2.809
5 (Test)	9	2.739	2.894
	10	2.636	2.806
5	50-word list	3.209	3.161

Table 2

Mean number recalled. All recall tests were given 48 hours after learning, except lists 5 and 6, which were tested 72 hours after learning.

Day	List	Group	
		Paced	Unpaced
1	1	20.50	21.00
	2	21.42	21.92
2	3	10.50	17.58
	4	13.75	14.50
3	5	6.42	9.58
	6	7.33	11.00
4	7	8.50	10.83
	8	8.08	9.25

Table 3

Analysis of variance of log total learning times for Days 4 (sum of lists 7 and 8) and 5 (sum of lists 9 and 10)

Source	d.f.	M.S.	F	p
Between Groups	1	941.08	2.015	n.s.
Between Ss Within Groups	22	467.033		
Between Ss	23			
Between Days	1	346.69	1.784	n.s
Days X Groups	1	674.52	3.472	n.s.
Pooled Ss X Days Within Groups	22	194.285		
Within Ss	24			
Total	47			

Table 4

Analysis of variance of recall scores for Days 1-4

Source	d.f.	M.S.	F	p
Between Groups	1	551.04	1.089	$> .05$
Between Ss Within Groups	22	505.996		
Between Ss	23			
Between Days	3	3279.373	49.96	$< .001$
Days X Groups	3	58.93	< 1	
Pooled Ss X Days Within Groups	66	65.637		
Within Ss	72			
Total	95			